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ABSTRACT

A clustering experiment applied co-citation analysis to a cumulation (1972-1974) of the Social Sciences Citation Index (SSCI) tapes in order to outline a citation structure for the social and behavioral sciences. Co-citation analysis is a new technique that establishes a link between two older documents and a crude metric of the strength of that link, by counting the number of times the two documents are jointly cited in new documents. The major finding was that the analysis could cluster documents so that related works appeared together and could display relationships among documents and among clusters of documents which reflect scientific content. In contrast to the natural sciences, the social and behavioral sciences utilized older documents and placed greater emphasis on scholarly monographs, even in those areas most closely related to biological sciences, such as parts of experimental psychology. Generally, published work in the social and behavioral sciences seems to be heavily influenced by exceedingly small groups of researchers, who are represented often by quite old documents and who are not readily displaced by new research. These findings raise questions about the operation and function of the social and behavioral sciences. (LMM)

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The Structure of the Social and Behavioral Sciences Literature

Belver C. Griffith

Henry G. Small

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THE STRUCTURE OF THE SOCIAL AND BEHAVIORAL SCIENCES LITERATURE

Belver C. Griffith
Drexel University
Philadelphia, PA

Henry G. Small
Institute for Scientific Information
Philadelphia, PA

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TABLE OF CONTENTS

I	Abstract	4
II	The structure of the social and behavioral sciences literature	5
III	Results	8
IV	Footnotes	27
V	References	29
VI	Tables	31
	1. Documents cited 200 times or more in the SSCI (1972-74)	31
	2. The mean number of citing and cited documents for the different divisions of clusters	33
	3. Locus of highly-cited clustered documents	34
	4. Dominance of cluster by a few researchers in the four cluster divisions	40

ABSTRACT

Co-citation analysis, already applied to the natural sciences' literature, was applied to the social and behavioral sciences' literature, as represented in that of the Social Sciences Citation Index. The major finding was that the analysis could cluster documents so that related works appeared together and could display relationships among documents and among clusters of documents which reflect scientific content. In contrast to the natural sciences, the social and behavioral sciences utilized older documents and placed greater emphasis on scholarly monographs. This proved true even in those areas most closely related to biological sciences, such as parts of experimental psychology. Generally published work in the social and behavioral sciences seems especially influenced by exceedingly small groups of researchers, who are represented often by quite old documents and who are not readily displaced by new research. These facts raise questions regarding the operation and function of the social and behavioral sciences.

THE STRUCTURE OF THE SOCIAL AND BEHAVIORAL SCIENCES LITERATURE

Some interesting developments in the study of science were stimulated by Derek Price's speculations, at different times and in different publications, that the structures of both social interactions and of bibliographic references were related to scientific achievement. Social structure has since been shown to be intrinsically related to scientific process, even at times, to the individual's cognitive style (e.g., the molecular biologist who discussed his work with an artist friend) and to the operation of certain social mechanisms, perhaps specific to science, for disseminating and controlling information and resources.

The earlier area of study, and one now witnessing rapid innovation, is the study of patterns in bibliographic references. This research is based on two modest assumptions:

1. If an author refers to (or cites) an earlier contribution, that cited document is more likely to be related to the author's work than one not cited;

2. If an author cites an earlier contribution, that cited document is more likely to be of value to the author's work than one also related but not cited.

While these assumptions appear highly plausible, they are coupled with a massive reservation:

> Measures of citations are tied to and no better than the data file which generates them, and this file can never be entirely accurate nor include the entire world's literature.

It has taken great experience with these measures to realize that the scientific literature contains a core of major journals, which behave reliably

year after year, and innumerable small journals, which do not. We now question, apart from practical difficulties, whether the inclusion of all the world's literature may even be desirable. Regarding these broad issues of reliability and validity, we should note that citation measures appear highly robust - certainly more so than comparable human judgments - and no major finding has been gainsaid.

Earlier work made clear the operation of "elitist" processes in the production of research and in the extent of research's influence on ongoing work; most articles and most influence come from a few brilliant scholars and scientists. Also evident was the extent to which scientific knowledge "grows at the skin," i.e., is based on comparatively recent past work. For reasons which the first author has discussed in more detail elsewhere, this work had comparatively restricted influence on the general understanding of science.

A new technique, simultaneously discovered in the United States and Russia, has furnished a new dimension to the study of science through bibliographic references. The method, called co-citation by American researchers, establishes a link between two older documents, and a crude metric of the strength of that link, by counting the number of times the two documents are jointly cited in new documents. The relationship between documents and metric, in turn, become fair game for tools like computerized clustering and multidimensional scaling, which were already well established.

The results for the natural sciences using the Science Citation Index file can be briefly summarized. The technique, with the occasional introduction of minor refinements, has been shown to group related documents and, in very fast fields of science, to generate groupings of very recent journal articles. Two articles in molecular biology were linked by new articles appearing in the same calendar year; several specialties reliably group year-old documents. For the first time, it is possible to identify a specialty literature and observe its structure, its relation to other specialized literature, and its pattern and rate of change. Size and time dimensions of the product of science can now be considered - even if the use of the measure is still at a first, primitive stage.

The primary structural unit which emerges in the natural sciences is the narrow subject-matter specialty, in which links among closely related papers are very strong. The promise inherent in the ability to monitor changes in the structure of these specialty clusters is that it will yield new insights into processes of growth and response to scientific discovery. On a broad scale, the mapping of inter-specialty relationships provides a tool for monitoring changes in the structure of the natural sciences as a whole.

With the advent of the Social Sciences Citation Index, intriguing questions arose: Could the same system be used to study the structure of the bahavioral sciences, and how would that structure differ from what we have observed for the natural sciences? (Since our clustering work with the SSCI has only just begun, we have not yet attempted to trace any changes in structure over time.) Other important questions were: Would co-citation analysis cluster and relate social science documents in a meaningful way? Would the experiment, taken as a whole, offer some promise of furnishing answers to the broad questions regarding the structure and achievements of the social and behavioral sciences? In seeking answers, we made comparisons with our earlier data on the Science Citation Index (SCI) to cast light on some of the more apparent differences between the natural and the behavioral sciences.

METHOD

This paper presents the results of a clustering experiment performed with a three-year cumulation (1972-74) of the SSCI tapes in an initial attempt to lay out an outline of a citation structure for the social sciences.[3] Although the clustering system used in this experiment has been presented in detail elsewhere, we shall describe the principal steps in the procedure.

The input file is either the SCI or the SSCI in a standard computerized format. A threshold of citation frequency is set (10 citations over three years here), and all items satisfying this threshold criterion are selected. In the next step, the file is rearranged by citing papers, creating reference

lists, for each paper, of only highly cited articles and permitting the creation of all co-citation pairs. An alphabetical file of individual co-citations is created, and then the number of cocitations counted for each pair of documents.

Once the pair of co-cited documents is identified and co-citations counted, a second threshold is set for document-document similarity for the purpose of input to a single-link clustering algorithm. This threshhold may be in terms of raw number of co-citations, obtained directly, or alternatively, a normalization procedure may be employed. The present experiment uses the Jaccard-Sneath coefficient of similarity, essentially an intersect (co-citations of document pairs) over union (total citation of both documents, minus co-citations). The specific Jaccard-Sneath thresholds tried here were 11.5%, 16% and 20%; the intermediate one proved the most useful. Finally, after all clusters have been formed at the specified level, the linkages between clusters are determined by consideration of document-document similarities lower than the clustering threshold. In this experiment, a count was made of the number of papers citing items in different clusters. This count is called the "cluster co-citation" frequency, and is a slight modification of the definition of this term used in our previous work.

RESULTS

Highly Cited Documents

In earlier work, we have analyzed successively more complex levels of the file, starting with the analysis of small document clusters, then examining the position of clusters in megaclusters, i.e., large clusters which are connected at lower thresholds of document-document similarity. We then try, where possible, to create a representation of the overall organization of the file. Before presenting results of this task, we would like to discuss the highly cited documents in this file and their functions, because of their sharp contrast to similarly highly cited documents in the natural sciences.

Table 1 (see pp 31) lists documents cited more than 200 times over the three-year period represented by the file. First inspection reveals two features of interest, namely, that the titles are overwhelmingly from the psychological literature and are nearly all books. Previous counts of the membership of American professional organizations in these disciplines would suggest that anthropologists, economists, linguists, sociologists, and psychologists stand in about a 1:2:2:8:16 ratio; thus the first result is not that surprising. The second result - that there are only three journal articles - is in quite marked contrast to the natural sciences and is, of course, of high interest.

An examination of these documents revealed a variety of contents and of functions. (Most were known to the first author, who was trained as an experimental psychologist; a few were discussed with other social scientists. Henceforth, these documents will be referred to by their first or sole author's name.) There are three documents with unique, but different, functions relative to the remainder of the list, namely those authored by Toffler, Kuhn and Miller. The first is a popular book, seemingly out of place in this list, that obviously captured some professional following. The Kuhn book, extremely well known in academe, combines history and philosophy of science in a message that is apparently quite attractive to this professional group. The remaining "misfit" in this list, Miller's journal article, is unique among highly cited documents in that it is a paper summarizing experiments arguing for a channel capacity limit for human information handling and, therefore, is analogous to highly cited natural science papers reporting major discoveries, e.g., super-conductivity.

The next group of documents parallels the natural sciences' most cited documents in terms of their dealing with research methods. There are three psychological statistics texts by Winer, Siegal and Hays; similar books are highly cited in SCI, too, principally because of their use in biological fields. The books by Osgood and Hollingshead deal with specific methods, the semantic differential and social class index, respectively. Rotter's psychological monograph reports a test for whether a subject regards events as

under his own or outside control (locus of control). Similar "tool" functions are served by the Thorndike volume, which is a data resource on word difficulty.

The most startling feature of this list, however, is the large number of major conceptual works. Listed by first author and area, they are: Bandura, clinical psychology; Chomsky, linguistics, psycholinguistics; Neisser, experimental psychology; Festinger and Heider, experimental social psychology; Merton and Parsons, sociological theory; Wolpe, clinical psychology; Katz, management and organization theory; and Fenichel, psychoanalysis. In addition, there are three works which contain both a specific method and a distinctive theoretical approach, falling directly between the two groups we just discussed. The books by Adorno and Rokeach are closely related, reporting authoritarianism and rigidity scales. Witkin's book reports tests of field dependence and independence. All three of the last named books deal with theory and experiment in personality psychology.

Skinner, Coleman and Jensen are at the interface of society, in the broad sense, and the professional, social and behavioral science disciplines. Skinner's book considers the implications of behavioral science for the western world's concept of mankind. The Coleman report on equality in education and the Jensen article on Black IQ are specific contributions to major societal controversies.

One approach to the analysis of highly cited documents which we have used previously is to create a spatial display using the technique of multi-dimensional scaling. We have performed this analysis on the twentysix documents cited two hundred times or more in the three-year SSCI file. The first step is to create a 26x26 matrix of co-citations among these documents. This matrix need only be a lower-half matrix with the diagonal missing because co-citation is a symmetric measure of relationship. This matrix is used as input to the M-D-SCAL program of Joseph Kruskal. The non-metric option of this program is used, and we derive a final configuration in two dimensions. This configuration is shown as Figure 1 (Stress II is equal to .44) with each document's position represented by the last name of the first author.

Fig 1

M-D-SCAL configuration of highly cited documents in SSCI file. The relative position of these documents, as represented by the placement of the last name of the sole or first author, was established by the number of times each document was cited together with each of the other documents. Table 1 serves as a key to document identity.

In light of the previous discussion of individual documents we see that the M-D-SCAL plot has mirrored many of the content relationships. For example, starting at the top of the figure, Kuhn is at one extreme and somewhat isolated. Three sociological texts are below Kuhn forming a small sub-group (Parsons, Merton and Katz). To the right of this subgroup are the books by Toffler and Skinner, both concerned with broad societal issues. Below the three sociological texts are the works by Jensen and Coleman relating to social and racial inequality. Two clinical psychology works appear to the right of these (Bandura and Wolpe), and the psychoanalytic text by Fenichel is to their immediate right. As we move down the figure we next encounter a region pertaining to social psychology (Hollingshead, Festinger and Heider). Rokeach and Adorno are paired very closely in this region as would be anticipated from their similar concerns. Continuing down the figure we see a gradual shift toward the psychology of individuals (Osgood and Rotter). Linguistics is to the left of these and somewhat isolated Chomsky. The three statistical texts (Siegel, Winer, and Hays) are grouped together in this region. The remaining four documents are more dispersed and separated as we move further down the figure. These items become increasingly related to cognitive psychology.

The M-D-SCAL structure is quite congruent to the content of these documents and was, of course, arrived at quite independently. Moreover, we can discern a broad differentiation of these documents along a single dimension which might be designated individual-social or hard science-soft science. Later, we see that this structural characteristic is also reflected in other aspects of the clustered file.

The tendency to cite major monographs is the most striking difference between the SCI and SSCI, and must be borne in mind in interpreting the subsequent data. For sake of comparison, of the 54 items cited 200 times or more in the 1973 SCI file, fully 42 of them can be categorized as biomedical method papers. Only 9 of the 54 items are books, the remainder being journal articles. In addition, in the SSCI file approximately 70% of the 50 documents cited between 100 and 200 times (and clustered) were also major monographs, and many of the articles in this group were from the

theoretical journal of American psychology (Psychological Review). Unfortunately, most of the extremely highly cited documents do not cluster, simply because few other documents are sufficiently cited to be co-cited 16% of the union of the two documents' summed citation rates.

Clusters and their Interrelationships

The principal analyses were, accordingly, concerned with 143 clusters - of any size - which were cited, over three years, in at least 100 different documents. At this point, let us try to put all the steps for arriving at these clusters in simple words. Documents cited at least 3 or 4 times a year in the social and behavioral sciences journal literature over the period 1972-74 were clustered by taking any document and adding new documents that link at threshold strength or above to previously selected documents. The threshold requires that the two linked documents be cited together roughly one time for every six times they are cited separately. Finally, only those clusters which are cited, on the average, by about 34 new documents per year were included in the 143 clusters which were closely studied.

The next steps in data analysis involved the identifying of the subject-matter content of each cluster and the "clustering of clusters." The first was achieved working from the titles of citing documents and by consulting the cited documents. In the second, the 143 clusters were themselves subjected to a single-link "clustering of clusters" at two levels, 10 and 20 cluster co-citations, i.e., requiring a link of 10 or 20 co-citing documents between clusters of documents rather than among individual documents. The outcome of "clustering of clusters" at a threshold of 20 co-citing documents per three years was two large networks of clusters, some minor groupings of clusters, and many isolated clusters, and this general breakdown of clusters proved very useful for subsequent analyses. We have, for this discussion, labeled these as "Softer" areas, "Harder" areas, "Minor Groupings" and "Isolates." (Appendices not reproduced here present the subject-matter content, the most-cited documents, the total citing and cited documents, and average date of cited document for each cluster in these groupings. The reader can obtain these data on request to determine, if only informally,

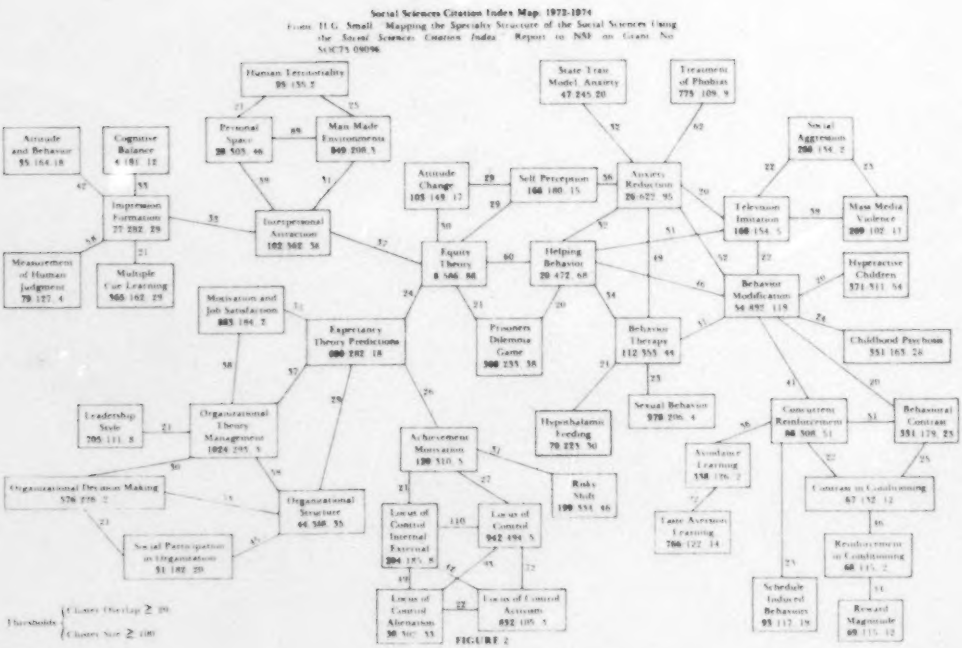

FIGURE 2

Fig 2

The network of document clusters in "softer" areas. The number of citing documents linking each cluster is shown beside each link. Only links representing 20 or more documents co-citing the linked clusters are shown. Within boxes the numbers are a) cluster ID, b) citing documents for the cluster, and c) cited documents in the cluster.

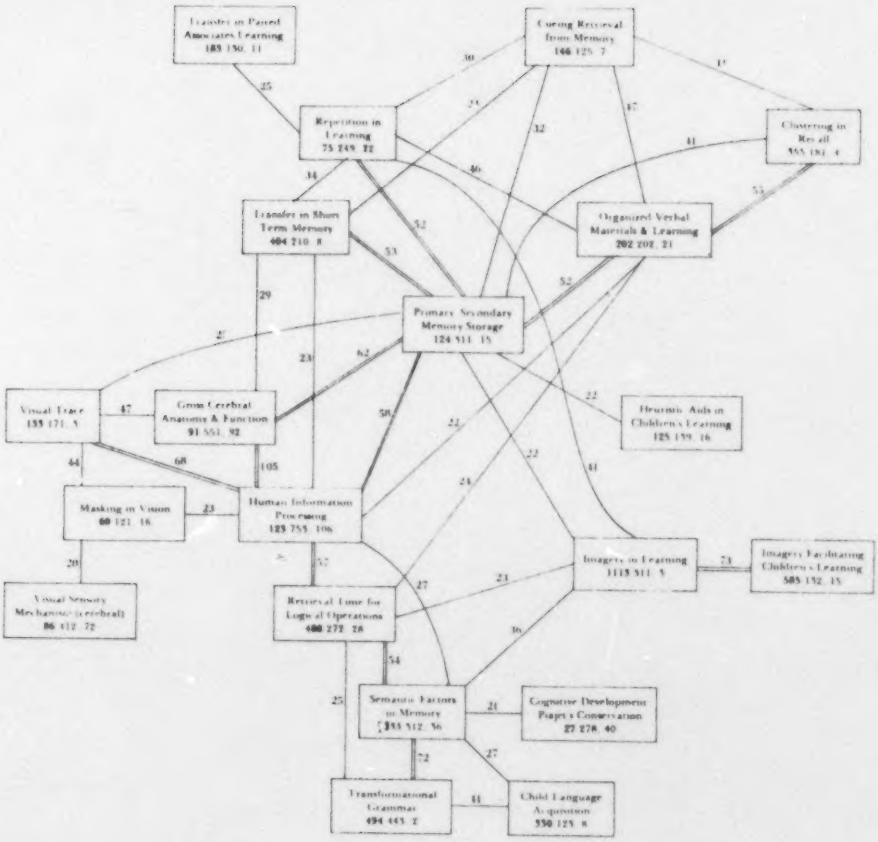

Fig 3

The network of document clusters in "harder" areas. The number of citing documents linking each cluster is shown beside each link. Only links representing 20 or more documents co-citing the linked clusters are shown. Within boxes the numbers are a) cluster ID, b) citing documents for the cluster, and c) cited documents in the cluster.

something about the validity of the procedure.) Clustering at level 10 linked nearly all clusters; in hindsight, not an unexpected finding since a "link" required only 10 new co-citing documents between groups of documents over a period of 3 years.

Figures 2 and 3 furnish some principal findings of this experiment. Figure 2 is especially important, linking together several, mostly "softer" disciplines and several levels of research on the basic-applied dimension; however, Figure 3 shows a good deal of interesting structure in experimental areas and presents several important points of contrast with Figure 2.

The reader should remain mindful of the degree to which other major research topics were "isolates" and did not link up to expected points in either figure, or with one another, including biofeedback training, sleep, psychophysical scaling (the Weber-Fechner Law), and evoded brain potential. The failure of these clusters to link with other clusters is, with these numerically low thresholds, an important finding.

"Softer" areas. Figure 2 can be seen, starting at the lower right and going to the upper left, as a long chain of basic research areas. The first portion, dealing with motivation and learning, is traditional areas of experimental psychology, normally involving a variety of training procedures using animals as subjects. One technique underlying many of these areas is operant conditioning, developed and employed by Skinner and followers.

The point joining to the next areas is a cluster labeled "behavior modification." This very large cluster, 119 documents, combines animal experiments and researchers (e.g., Sidman and Herrnstein) with experimental clinical psychologists working with similar procedures and theory, but using them on people (e.g., Lovaas and Salzinger). This cluster then, in turn, ties to a series of clusters which are primarily applied to clinical psychology (upper right corner of the figure). Moving from right to left, we move into social psychology, including "helping behavior," "prisoners dilemma game," "self-perception," "attitude change," and "equity theory." The last named cluster involves considerable sociology and applied work, and when the

clustering criterion is raised to a Jaccard-Sneath coefficient of 20%, splits into two sections, one psychological, the other sociological. All work shares theory but splits mainly on method observation or survey (sociology) vs. experiment (psychology). The remaining links move into area evaluating and modeling subjective impressions, finally including, again, experimental psychology. The largest appendage, lower left center, clearly includes organizational theory and industrial psychology. Also in that area are two clusters of research: "achievement motivation" and "risky shift" (group vs individual decision-making) which reflect research that would normally be done in business schools. A group of clusters deal with whether people view events as under their own or external control ("locus of control"). (One of these, No. 942, corresponds to method papers which are too highly cited to be readily linked with other papers.) The largest of these in terms of clustered documents, No 30, is the second point at which substantial numbers of sociological documents are included. The remaining, smaller appendages on Figure 6 tend to be either more applied in orientation or more specific in content.

The striking feature of Figure 2 is the many clusters which represent the work of only a couple of men or laboratories. When clusters were examined to discover the degree to which they are the work of only 13 persons or teams, it became evident, despite the hundreds of citing papers, that the "softer" areas were nearly a network of handfuls of what might be termed "charismatic documents." This finding is more fully discussed below in the context of comparing different literatures.

"Harder" areas. Figure 3 reveals two areas. One is marked by a series of highly interactive clusters in verbal learning and memory. As the many linkages indicate, these are closely related areas and represent some old questions (as, for example, the role of repetition in learning), some new experiments (Peterson and Peterson's short term memory procedure and cueing retrieval from memory), a new theoretical approach (different levels of memory storage), and the extension of an earlier finding (clustering and organized, "preclustered" materials in learning). Two peripherally attached clusters return to the tradition of Titchener and deal anew with imagery and learning.

A second grouping on the lower left, falls on a reasonable axis in human experimental psychology from linguistics to sensation and perception. The extreme bottom cluster, "transformational grammar", consists of the two Chomsky texts, and involves more than linguistics. (Only 90 of 443 citing documents co-cited these books, and 24 of these were from what were, in our judgment, "core" psychology journals.)

Continuing to the upper left along this axis, one finds "semantic factors in memory" and "retrieval time for logical operations." The first deals with studies showing that syntactical features or "deep structure" are not retained, a semantic "image" or "situation" is retained. The second contains a differential reaction time experiment in which human subjects must carry out a logical operation prior to a response. The next two clusters, "human information processing" and "gross cerebral anatomy and function" contain 106 and 92 documents, respectively, and are, with this clustering technique, too large to analyze fully. The first deals broadly with human performance in response to complex signals and contains much work on audition. The second contains studies utilizing a variety of methods but all concerning the localization of function in the brain. Many studies deal with hemispheric differences in the understanding of speech in responding to different learning tasks. Post-operative behavioral evaluations, following brain surgery, are reported in others of these clustered documents.

The three clusters at the end of the axis contain studies of vision. Two are concerned with the visual trace (No 133) and its masking (No 60), and the third deals with a quite startling series of discoveries regarding the organization of neural pathways in the visual cortex (No 86) termed "feature analysis units." The work in this last cluster is regarded as raising the possibility of explaining "Gestalt" phenomena neurologically.

The M-D-SCAL representation of this "cluster of clusters" confirms the graph structure just discussed (see Figure 3). The two-space M-D-SCAL map has been orientated (rotated) so as to correspond, roughly, to the orientation of the graph representation. Again, we see tri-polar arrangements with a region containing the vision clusters at one pole, language research clusters

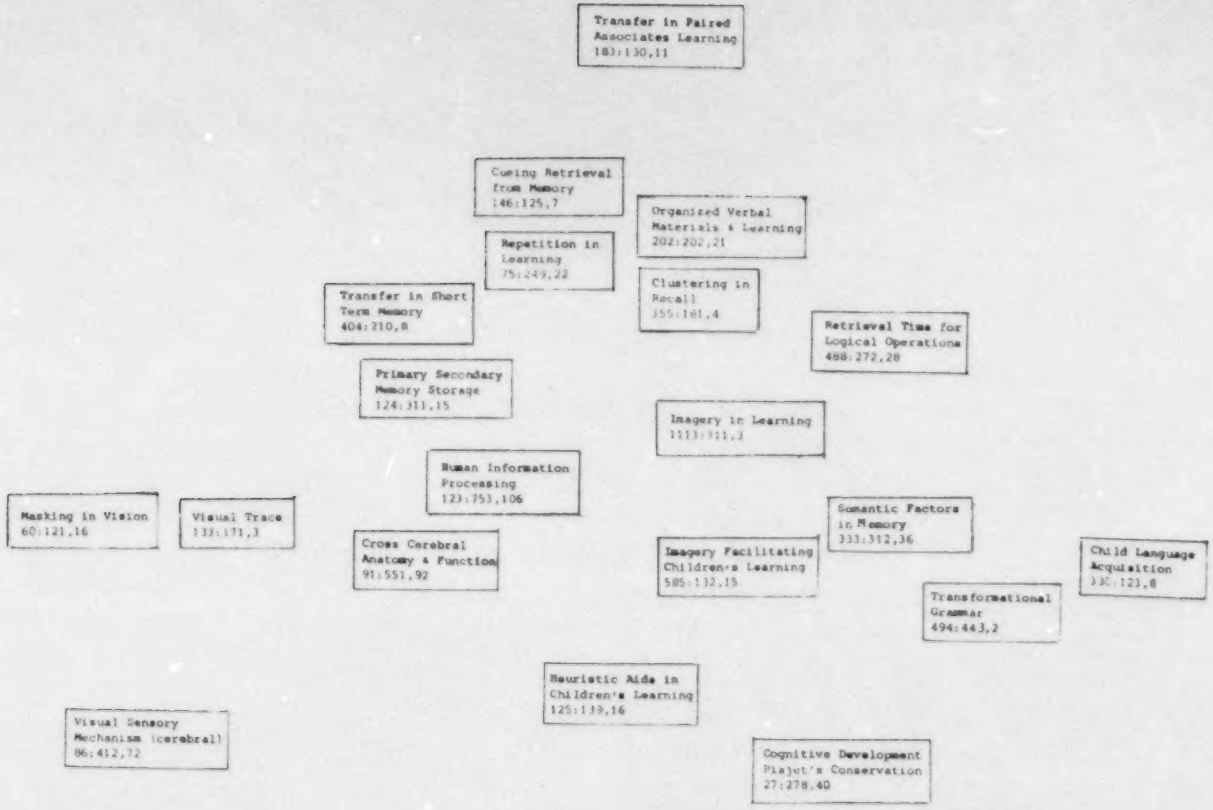

Fig 4

M-D-SCAL configuration of "harder" areas. The relative position of these clusters was established by the number of times each cluster was cited together with any of the other clusters.

at the second and human verbal learning at the third (top) pole. This comparison of the network representation and M-D-SCAL map shows that drawing only the strongest links among clusters and attempting to arrange the clusters so as to minimize line crossing captures a good deal of the structure inherent in the network. M-D-SCAL, however, reflects all linkages regardless of strength, thus using more data, and should be regarded as the more accurate form of representation.

"Minor groupings." The nine groups of clusters in this category ranged in size from five to two clusters (not shown). These groupings mainly involve clusters with closely related content or a combination of substantive area and the methods that are frequently employed, as e.g., social differentiation and stratification and path analysis. The grouping of chief interest is the largest which seems to contain only medically-oriented psychiatric specialties, excluding both psychology and psychoanalysis.

"Isolates." On first inspection, the isolated clusters (not shown) appear overwhelmingly diverse in subject-matter and unmanageable to analysis. Certain features do emerge when compared to the earlier groupings - and some details are of high interest indeed.

These clusters have a far more practical cast of complexion. In part, this reflects the emergence of parts of economics, finance, and law as isolated clusters and, in part, the development of clusters around questions which, while extremely specific, have high societal value, as, e.g., use of health-care services. We believe that most academics would regard about thirty of these 53 clusters as having more a "practical" than a "basic" orientation, including the clusters dealing with mental problems and the offering of mental health services.

The isolated clusters include a number of specific methodological techniques (factor analysis, Goodman's analysis of categorical data, and utility functions) and a number of basic areas of experimental psychology, apparently too specific to link to other documents. The most startling cluster consisted of references to the standard edition of the works of

Sigmund Freud, and an additional document by Schur. This cluster's existence and its datedness (1925) raised questions regarding scientific progress and "great men," which will be considered in later sections.

Comparisons among literatures. Despite the enormous differences in magnitude of SCI and SSCI annual files, it was possible to create a file matched in several important ways to the SSCI. The year selected for SCI (1973) is intermediate to the three years (1972-1974) for SSCI, giving an approximate match for date of citing items. Using only one year of SCI and raising the threshold for the selection of highly cited items from 10 to 15 resulted in a rough parity between SCI and SSCI in terms of total number of cited items. However, the comparison of files differing so widely in dimensions is very tentative and, in the end, we discarded most analyses. We did compare the average date of the 20 largest clusters in each file. The mean date of the 1973 SCI clusters is 1969.6, fully three years more recent than the mean date for SSCI, which is 1966.5.

Table 2* compares the four divisions we have made among the 143 clusters cited by 100 or more documents. There are only two features worth much note: The mean date of clustered cited documents becomes less recent in going from "harder" to "softer" areas. The number of cited and citing documents per cluster is smaller for the "Minor Groupings" and "Isolates" and implies that statistical noise, as well as underlying content, may affect the failure to attach to the larger "softer" and "harder" networks of clusters.

The next comparison is on the basis of the locus of highly cited, clustered documents, and Table 3* presents these data. The two large networks show, going from "softer" to "harder," a reduction in books and an increase in the percentage of contributions clustered from the Psychological Review, the second most frequent locus. Books also are the most frequent locus for the smaller division of clusters, "minor Groupings" and "Isolates."

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* Table 2 see p 33
Tabel 3 see pp 34-39

The final area of comparison is with regard to "charismatic" people and documents. Table 4* presents the total citations attributed to only one or two first authors for each cluster for those clusters which seem to be dominated by the work of one or two persons. For comparison, but not a strict one, the total citing documents are shown for that cluster. The table is divided according to the four divisions of the 143 studied clusters.

These results are clear. The proportion of clusters reflecting the dominance of one or a couple of researchers or teams diminishes as the field becomes harder; and in fact, a majority (25) of the "softer" clusters were dominated by the work of three or fewer persons. If one considers those fields so dominated among the "Minor Groupings" and "Isolated" clusters, they seem to be more "basic" than "applied" in orientation. This last finding is more striking in view of the size of these clusters which are smaller and therefore presumably more likely to be dominated by a small group of research workers.

"Great men." At one stage of analysis, we were struck by the apparently arbitrary pattern of inclusion and exclusion of important researchers and scholars. Some were evident, particularly among documents cited 200 or more times, but others were quite elusive, even following our analysis of "dominant" researchers for individual clusters. (The reader may wish to reexamine Tables 1 and 4 for this aspect.) To be sure that we had some understanding regarding these persons and their published works, we consulted the published SSCI and searched the files generated for this study on a number of authors. These persons included Nobel Laureates in economics and neurophysiology and other major figures.[4]

The outcome of these analyses was understandable but perhaps only mildly enlightening. There was no "general case," and some were difficult to interpret. Perhaps the most cited eminent omission or near-omission was Karl Marx. This was a reflection of almost pure bibliographic chaos in the publishing and referencing of his works. The few major works appear in many languages and many editions - in striking contrast to the standard edition of Freud.

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* Table 4 see pp 40-53

Several other older, internationally-known figures suffered similar fates, although none was as frequently cited or "editioned" as Marx. Most recent works seem, however, to have a standard edition, and most appear well cited in the file, but either are too diversely cited to cluster at a high level with a group of documents (Keynes' major works), or cluster with only another highly cited work (Hull and Spence on learning theory).

Finally, there were obviously few workers, as evidenced by new citing documents appearing in SSCI, in certain highly technical areas of sensory neurophysiology (Wald, Bekesy) and economics (Kuznets). Further work on the relation of such important figures to the structure revealed here is clearly required.

Discussion

These analyses present a variety of findings, which seem more or less valid depending upon their repeated appearance in different forms and levels of analysis. It seems clear that the SSCI is theory-rich, old, and loaded with monographs. Within the SSCI, the "softer" areas, relative to "harder" areas, are older and even more theory-rich and loaded with monographs. In addition, "softer" clusters are more likely to be dominated by the work of only one or two men. More speculatively, we wonder whether there is, even among these theory-rich documents, much theory that is integrative of "applied" or "broader" areas like economics, law, or mental health, which fell largely among the isolated clusters.

These results, both comparisons to the natural sciences and internal comparison between "harder" and "softer" areas, open several new questions regarding the social and behavioral sciences. Earlier writers have discussed various aspects of the natural vs. social and behavioral sciences, including the degree of consensus, the use of older literature, and the lack of orderly dissemination mechanisms, including unusually high use of books and the greater scattering of documents among journals. Under the conditions set within our experiment, we have results that suggest, in the context of earlier studies of the natural sciences, a "pathology": the use of old

literature, the extreme use of texts in preference to articles; and the grouping of the older works of influential authors into small, apparently inpenetrable clusters. (In the most pathological case, psychoanalysis, almost all references are to the work of one man, Freud, now long dead.) An examination of our data in full (some unreproduced here) suggests that, in the extreme cases, the "softest" - citations seem patterned not about issues and current work, which would be presumably proven or disproven and rapidly replaced, but about people, whose authority seem to linger long after death, unchallenged by continuing work.

These interpretations must be examined and considered within the special conditions set by our experiment. The main ones are, of course, limiting the data to citations within recent periodicals and examining chiefly those docuemnts that closely relate to one another in terms of being frequently co-cited. These conditions produce clear results in the analysis of the natural sciences, namely, the emergence of important journal articles as critical events in the development of specialties and rapid change in documents reflecting new empirical discoveries, changing issues in specialties, and the acceptance and rejection of new concepts and methods.

The large issue is what is different about the social and behavioral sciences? The view supported by all the bits and pieces is that they are either "pathological" or that the method or "logic of science" may not fit well with their objects of study. Candidates for the type of underlying mechanisms which would generate these results include:

1) There are very slow changes in concepts and methods (or "paradigm"). The literature is largely peripheral to such changes that do occur. Most work is either applied or redundant.

2) The journal article is, for many parts of social science, a poor vehicle of communication, ill-suited to discuss extremely complex issues. Books are, in fact, the medium through which change is really effected.

3) There are no well established mechanisms for the acceptance and rejection of ideas and findings. The normal system of journals, abstracting journals, reviews, etc., as originally invented and developed in the natural sciences, requires amplification and elaboration for use in social and behavioral sciences. For example, formal reviewing services, the Annual Reviews and Psychological Bulletin, might require additonal formal and informal supporting mechanisms.

4) There may be very subtle difficulties about change and process in the behavioral science. These have to do with the orderly pattern, which applies not too badly to natural science, of "paradigm" (or Popper's "prejudices"), "knowledge of the research problem" (Popper), "conjecture," and "refutation." Simply stated:

a) The nature of refutation is not built into behavioral science conjectures as clearly as into those in the physical science. Many of the documents discussed here would not meet Popper's requirement that a refuting study could be easily devised or imagined.

b) There may be, for all behavioral sciences, a limited range of approaches from which new conjectures can be derived after refutation. Perhaps the easiest way to consider this problem is to review Kuhn's example of astrology's response to refutation, which was limited to ever more exact determinations of time. While more varied than astrology - behavior can be measured and viewed in different ways and the organism's neurophysiology explored in different ways (some strikingly new) - many approaches are old and well explored.

At this time, we cannot distinguish among these quite broad hypotheses. But we can see that each of them would contribute to an overall situation in which the relative importance of people vs. factual content favors people. We suspect, in view of some awareness of the scientific issues, that several

of these hypotheses may hold, depending on the specialty. Indeed, the specialties studied here varied radically among themselves; perhaps, for many purposes, the "healthier" deserve deliverance.

In conclusion, it is clear that apparent similarities between dissemination mechanisms in the natural and behavioral sciences may have masked differences in the underlying operation, as already observed by Garvey et al. On the basis of these new data, we can now go further and claim that they have also masked major epistemological difficulties wich can only emerge when we examine the structure of behavioral science literature.[5]

FOOTNOTES

1) The research was supported by grant R01-LM00911-5 from the Public Health Service and, through faculty leave to the first author, by Drexel University. The work of the second author was supported by NSF grant SOC7309096, which also supported the generation of the cluster files. The authors thank Howard D. White for much editorial help and advice.

2) We will try to follow the procedure of footnoting most references and qualifications at the beginning or end of each section rather than frequently breaking the line of reasoning within the text itself. Earlier research on the social structure of science was reviewed by Crane in Invisible Colleges (1972). Coser (1975) Merton (1977), Mulkay (1977), and Gaston (1980) bring that up to date. Some contrasts in the functions of informal interactions can be seen in Garvey and Griffith (1972) and Griffith and Mullin (1972). The seminal works of Derek Price are Science Since Babylon (1961) and Little Science, Big Science (1963). Data regarding the reliability of citation counts for authors is presented by Cole and Cole (1973); the best data on the reliability of citation counts for individual documents has been obtained by Virgo (1974). The co-citation technique was first reported by Small (1973) and Marshakova (1973). The further major development of the method is described by Small and Griffith (1974), Griffith, Small, Stonehill and Dey (1974), and Garfield, Malin, and Small (1978), Griffith (1979) addresses the failure of statistical studies of science to impact the history and philosophy of science.

3) The Social Sciences Citation Index (SSCI) covers roughly 1400 journals in full and 1200 journals in part for contributions to various branches of the social and behavioral sciences. Some of the major areas covered are: anthropology journals (57), business and finance (62), economics (117), education (156), history (62), law (109), management (41), political science (81), psychiatry (87), psychology (169), and sociology (150). In addition, roughly 30 smaller areas are represented by selections of core journals. Three annual cumulations of the SSCI data base (1972, '73, '74)

were merged to create a special file for this clustering experiment. The merged file consisted of 1,895,2958 citations to 1,170,280 distinct cited items, from 226,121 source articles.

4) These files were carefully examined for the work of the following: Marx, Freud, Durkheim, Weber, Piaget, Myrdal, Samuelson (Paul), Bekesy, Wald (George), Kuznets, Mead (Margaret), Pareto, Allport (Gordon), Parsons, Merton, Hull, Spence, Skinner, and Keynes. There are various lists of achievers and achievements in these areas, the most daring being Deutsch, Platt and Senghaas (1971), and our intent was to balance among fields and between classical and recent major figures.

5) The principal earlier work contrasting hard, natural, science and soft, social science was Price (1970) and Garvey, Lin and Nelson (1979). The most direct introduction to the work of Popper is his own article (1963), although anyone who is seriously interested should consult his well known books. Kuhn develops his example of astrology in Lakatos and Musgrave (1970). The last mentioned book is an excellent introduction to some major issues and recent writings on the philosophy of science, and this section reflects such writings in ways that cannot be fully acknowledged. Recently, Brittain has speculated in a similar way regarding problems of verification and the lack of consensus in the social science. The failure of social science to rid itself of the old and famous, discussed in the present paper, relates well to his ideas of verification by "armchair philosophizing" and repetition. M. Carl Drott contributed the idea that refutation is more explicitly part of conjecture in hard science than in the social sciences and scholarship. Comparative data on the structure of natural sciences appears in Griffith et al (1974) and Small (1977).

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TABLE 1

Documents cited 200 times or more in the SSCI (1972-74)

Author	Document	Year	Citation Frequency 1972-74
Winer, B.J.	Statistical Principles in Experimental Design, New York, McGraw-Hill	1962	1333
Siegel, S.	Non-parametric statistics for the behavioral sciences, New York, McGraw-Hill	1956	1020
Osgood, C.E., Suci, G.J. & Taunenbaum, P.H.	Measurement of meaning, Urbana, University of Illinois Press	1957	480
Bandura, A.	Principles of behavior modification, Cambridge, M.I.T. Press	1969	422
Chomsky, N.	Aspects of the theory Syntax, Cambridge, M.I.T. Press	1965	382
Rotter, J.B.	Generalized Expectancies for Internal versus External control of Reinforcement, Psychological Monographs, General and Applied, 80, 1-28	1966	381
Neisser, U.	Cognitive psychology, New York, Appleton-Century-Crofts	1967	334
Festinger, L.	Theory of cognitive dissonance, Evanston, Illinois, Row Peterson	1957	328
Heider, F.	Psychology of interpersonal relations, New York, Wiley	1958	315
Merton, R.K.	Social theory and social structure, Glencoe, Illinois, Free Press	1957	313
Hollingshead, A.B. & Redlich, F.C.	Social class & mental illness; a community study, New York, Wiley	1958	303
Coleman, J.S., et al	Equality of educational opportunity, Washington, D.C., U.S. Government Printing Office	1966	296
Hays, W.L.	Statistics for psychologists, New York, Holt, Rinehart and Winston	1963	283

Rokeach, M.	Open & closed mind; investigations into the nature of belief systems and personality systems, New York, Basic Books	1960	277
Wolpe, J.	Psychotherapy by reciprocal inhibition, Stanford; University Press	1958	275
Toffler, A.	Future Schock, New York, Random House	1970	268
Adorno, T.W., et al	Authoritarian personality, New York, Harper	1950	240
Jensen, A.R.	How much can we boost IQ and scholastic achievement? Harvard Educational Review, 39, 1-123	1969	226
Witkin, H.A., et al	Psychological differentiation; studies of development, New York, Wiley	1962	219
Kuhn, T.S.	Structure of scientific revolutions, Chicago, University of Chicago Press	1962	217
Thorndike, E.L.	Teachers' word book of thirty thousand words found most frequently & widely in general reading for children and young people, New York, Columbia University, 1932 (original edition)	1944	217
Parsons, T.	The social system, Glencoe, Illinois, Free Press	1951	214
Skinner, B.F.	Beyond freedom and dignity, New York, Knopt	1971	208
Miller, G.A.	The magical number seven, plus or minus two, some limits on our capacity for processing information, Psychological Review, 63, 81-97	1956	203
Katz, D. & Kahn, R.L.	Social psychology of organizations, New York, Wiley	1966	202
Fenichel, O.	Psychoanalytic theory of neurosis, New York, Norton	1945	201

TABLE 2

The Mean Number of Citing and Cited Documents for the Different Divisions of Clusters

Divisions	N (Clusters)	Means		
		Citing Documents	Cited Documents	Date Cited Documents
"Softer" Areas	47	248.3	24.2	1965.23
"Harder" Areas	20	271.3	26.5	1966.61
Minor Groupings	23	172.3	18.0	1964.48
Isolates	53	145.35	14.0	1964.85

TABLE 3

Locus of Highly-cited Clustered Documents

Sources[a]	Number of Documents from Source	Percent of Documents in Division of Cluster[b]
	"Softer" Areas	
Books	48	27.0
Psychological Review	19	10.7
Journal of Personality & Social Psychology	16	9.0
Journal of Abnormal & Social Psychology	11	6.2
Journal of the Experimental Analysis of Behavior	8	4.5
Psychological Bulletin	8	4.5
American Sociological Review	5	2.8
Journal of Experimental Psychology	5	2.8
Administrative Science Quarterly	4	2.2
Human Relations	4	2.2
American Psychologist	3	1.7
British Journal of Psychiatry	3	1.7

a) Listing cut at sources containing two or more cited documents.

b) Numbers are 178, 78, 86, and 209 for the groupings as oredered below.

TABLE 3 (Continued)

Locus of Highly-cited Clustered Documents

Child Development	3	1.7
Psychological Monographs	3	1.7
Behaviour Research & Therapy	2	1.1
Journal of Conflict Resolution	2	1.1
Journal of Experimental Social Psychology	2	1.1
Journal of Social Issues	2	1.1
Psychological Report	2	1.1
Psychonomic Science	2	1.1
Sociometry	2	1.1
"Harder" Areas		
Books	11	14.1
Psychological Review	12	15.4
Journal of Verbal Learning & Verbal Behavior	11	14.1
Journal of Experimental Psychology	8	10.2
Perception & Psychophysics	5	6.4
Psychological Bulletin	5	6.4
Journal of Physiology, London	4	5.1

TABLE 3 (Continued)

Locus of Highly-cited Clustered Documents

Developmental Psychology	3	3.8
Journal of Experimental Child Psychology	2	2.6
Psychological Monographs	2	2.6
Acta Psychologica	2	2.6
Minor Groupings		
Books	25	29.1
Archives of General Psychology	6	7.0
Psychometrika	5	5.8
British Journal of Psychiatry	4	4.6
Journal of Comparative & Physiological Psychology	4	4.6
American Journal of Psychiatry	3	3.5
American Sociological Review	3	3.5
Harvard Law Review	3	3.5
Psychological Bulletin	3	3.5
American Journal of Sociology	2	2.3
Journal of Abnormal Psychology	2	2.3
Journal of Mathematical Psychology	2	2.3
Journal of Nervous and Mental Disease	2	2.3

TABLE 3 (Contined)

Locus of Highly-cited Clustered Documents

Merrill Palmer Quarterly	2	2.3
Monographs for the Society for Research in Child Development	2	2.3
Pharmacological Review	2	2.3
Isolates		
Book	67	32.06
Psychological Bulletin	7	3.35
Psychological Review	7	3.35
Science	6	2.87
American Sociological Review	6	2.87
Archives of General Psychiatry	5	2.39
American Journal of Psychiatry	4	1.91
Econometrica	4	1.91
Journal of Experimental Psychology	4	1.91
Journal of Psychosomatic Research	4	1.91
American Economic Review	3	1.44
American Journal of Sociology	3	1.44
American Political Science Review	3	1.44

TABLE 3 (Continued)

Locus of Highly-cited Clustered Documents

Annals of Internal Medicine	3	1.44
Exceptional Children	3	1.44
Journal of Consulting Clinical Psychology	3	1.44
Journal of Social Issues	3	1.44
Psychometrika	3	1.44
American Anthropologist	2	.96
American Sociologist	2	.96
British Journal of Psychiatry	2	.96
British Medical Journal	2	.96
Economica	2	.96
Journal of Abnormal and Social Psychology	2	.96
Journal of the American Medical Association	2	.96
Journal of the American Statistical Association	2	.96
Journal of Conflict Resolution	2	.96
Journal of Educational Psychology	2	.96
Journal of Law and Economics	2	.96
Journal of Mathematical Psychology	2	.96
Journal of Nervous and Mental Diseases	2	.96

TABLE 3 (Continued)

Locus of Highly-cited Clustered Documents

Journal of Personality and Social Psychology	2	.96
Journal of Political Economics	2	.96
New England Journal of Medicine	2	.96
Psychopharmacologica	2	.96
Quarterly Journal of Studies on Alcohol	2	.96
Review of Economics Statistics	2	.96
Review of Economic Studies	2	.96

TABLE 4

Dominance[a] of Cluster by a Few Researchers in the Four Cluster Divisions

Cluster (Number) Author	Cited Documents in Cluster	Citing Documents for Cluster	Summed Citations to Author's Work	Number of Cited Books or Chapters by Author	Number of Other Documents by Author[b]
"Softer" Areas					
REWARD MAGNITURE (69)	12	115			
E. Capaldi			96	3	2
REINFORCEMENT CONDITIONING (68)	2	145	180		
A. Amsel			180	-	2
SCHEDULE - INDUCED BEHAVIORS (93)	19	117			
J. Falk			86	-	4
TASTE AVERSION (766)	14	122			
P. Rozin			64	-	1
J. Garcia			120	-	6
AVOIDANCE LEARNING (338)	2	125			
R. Bolles			86	-	1
M. Seligman			63	-	1

TABLE 4 (continued)

Dominance of Cluster by a Few Researchers
in the Four Cluster Divisions

Cluster (Number) Author	Cited Documents in Cluster	Citing Documents for Cluster	Summed Citations to Author's Work	Number of Cited Books or Chapters by Author	Number of Other Documents by Author
		"Softer" Areas			
BEHAVIORAL CONTRAST (331)	23	179			
H. Terrace			134	-	6
CHILDHOOD PSYCHOSIS (351)	28	163			
L. Kanner			103	1	3
M. Rutter			126	1	6
SEXUAL BEHAVIOR (978)	4	206			
A. Kinsey			174	1	-
W. Masters			126	2	-
MASS MEDIA VIOLENCE (269)	11	102			
L. Berkowitz			77	-	4
SOCIAL AGRESSION (268)	2	134			
J. Dollard			80	1	-

TABLE 4 (Continued)

Dominance of Cluster by a Few Researchers
in the Four Cluster Divisions

Cluster (Number) Author	Cited Documents in Cluster	Citing Documents for Cluster	Summed Citations to Author's Work	Number of Cited Books or Chapters by Author	Number of Other Documents by Author
		"Softer" Areas			
L. Berkowitz			79	1	-
TREATMENT OF PHOBIAS (775)	9	109			
I. Marks			40	1	1
M. Gelder			53	-	2
J. Watson			44	-	2
STATE-TRAIT (47)	20	245			
C. Speilberger			144	3	-
N. Endler			113	-	5
SELF-PERCEPTION (166)	15	180			
D. Bem			183	-	4
PRISONERS DILEMMA (308	38	233			
M. Deutsch			172	-	6

TABLE 4 (Continued)

Dominance of Cluster by a Few Researchers
in the Four Cluster Divisons

Cluster (Number) Author	Cited Documents in Cluster	Citing Documents for Cluster	Summed Citations to Author's Work	Number of Cited Books or Chapters by Author	Number of Other Documents by Author
		"Softer" Areas			
INTERPERSONAL ATTRACTION (102)	38	362			
D. Byrne			283	1	10
MAN-MADE ENVIRONMENTS (849)	3	208			
E.T. Hall			202	2	-
R. Sommer			72	1	-
HUMAN TERRITORIALITY (95)	2	135			
K. Lorenz			85	1	-
R. Ardrey			74	1	-
MEASUREMENT OF HUMAN JUDGMENT (79)	4	127			
N. Anderson			139	-	2
D. Krantz			27	-	2
LOCUS of CONTROL: Activism (832)	3	105			
P. Gurin			73	-	1

TABLE 4 (Continued)

Dominance of Cluster by a Few Researchers
in the Four Cluster Divisions

Cluster (Number) Author	Cited Documents in Cluster	Citing Documents for Cluster	Summed Citations to Author's Work	Number of Cited Books or Chapters by Author	Number of Other Documents by Author
"Softer" Areas					
LOSS OF CONTROL: ALIENATION (30)	33	302			
M. Seeman			216	-	6
LOCUS OF CONTROL (942)	5	494			
J. Rotter			501	-	2
ACHIEVEMENT MOTIVATION (120)	5	310			
D. McClelland			182	2	-
J. Atkinson			276	3	-
MOTIVATION AND JOB SATISFACTION (883)	2	184			
F. Herzberg			220	2	-
LEADERSHIP STYLE (705)	8	111			
F. Fiedler			140	1	3
G. Graen			20	-	1

TABLE 4 (Continued)

Dominance of Cluster by a Few Researchers
in the Four Cluster Divisions

Cluster (Number) Author	Cited Documents in Cluster	Citing Documents for Cluster	Summed Citations to Author's Work	Number of Cited Books or Chapters by Author	Number of Other Documents by Author
		"Softer" Areas			
ORGANIZATIONAL THEORY: Management (1024)	3	293			
R. Likert			240	2	-
D. McGregor			136	1	-
		"Harder" Areas			
IMAGERY IN LEARNING (1113)	3	311			
A. Paivio			429	-	3
IMAGERY FACILITATING CHILDREN'S LEARNING (585)	15	132			
A. Paivio			83	-	4
W. Rohwer			70	-	4
CLUSTERING IN RECALL (355)	4	181			

TABLE 4 (Continued)

Dominance of Cluster by a Few Researchers
in the Four Cluster Divisions

Cluster (Number) Author	Cited Documents in Cluster	Citing Documents for Cluster	Summed Citations to Author's Work	Number of Cited Books or Chapters by Author	Number of Other Documents by Author
E. Tulving			122	-	2
G. Mandler			66	-	1
W. Bousfield			60	-	-
CUEING RETRIEVAL FROM MEMORY (146)	7	125			
E. Tulving			121	-	3
REPETITION IN LEARNING (75)	22	249			
B. Underwood			174	-	6
VISUAL TRACE (133)	3	171			
G. Sperling			186	-	2
E. Auerbach			58	-	1
TRANSFORMATIONAL GRAMMAR (494)	2	443			
W. Chomsky			531	2	-

TABLE 4 (Continued)

Dominance of Cluster by a Few Researchers
in the Four Cluster Divisions

Cluster (Number) Author	Cited Documents in Cluster	Citing Documents for Cluster	Summed Citations to Author's Work	Number of Cited Books or Chapters by Author	Number of Other Documents by Author
		Minor Groupings			
DEPRESSION (222)	2	131			
M. Hamilton			93	-	-
A. Beck			59	-	-
COGNITIVE COMPLEXITY (174)	4	127			
G. Kelly			187	1	-
D. Bannister			67	1	-
COGNITIVE COMPLEXITY (867)	2	115			
H. Schroder			69	1	-
O. Harvey			67	1	-
METRICS OF SUBJECTIVE IMPRESSIONS (126)	13	108			
G. Ekman			85	-	5

TABLE 4 (Continued)

Dominance of Cluster by a Few Researchers
in the Four Cluster Divisions

Cluster (Number) Author	Cited Documents in Cluster	Citing Documents for Cluster	Summed Citations to Author's Work	Number of Cited Books or Chapters by Author	Number of Other Documents by Author
		Minor Groupings			
MULTI-DIMENSIONAL SCALING (996)	4	196			
J. Kruskal			246	-	2
R. Shepard			148	-	2
SOCIAL DIFFERENTIATION AND STRATIFICATION (45)	22	184			
W. Sewell			149	-	6
COUNSELOR EMPATHY LEARNING (459)	2	176			
C. Tranx			146	1	-
R. Carkhuff			60	1	-
INFANT VISUAL DEVELOPMENT (339)	30	122			
R. Fantz			114	1	6
R. McCall			69	1	4

TABLE 4 (Continued)

Dominance of Cluster by a Few Researchers
in the Four Cluster Divisions

Cluster (Number) Author	Cited Documents in Cluster	Citing Documents for Cluster	Summed Citations to Author's Work	Number of Cited Books or Chapters by Author	Number of Other Documents by Author
Minor Groupings					
BEHAVIORAL ROLE OF HIPPOCAMPAL CONNECTION (624)	2	119			
R. Douglas			95	-	-
D. Kimble			71	-	-
Isolates					
CHANGE COMPONENTS OF ADULT DEVELOPMENT (71)	38	257			
K. Shaie			139	1	4
P. Baltes			109	1	6
FACTOR ANALYSIS (82)	12	134			
H. Kaiser			73	1	2
K. Joreskog			80	1	3

TABLE 4 (Continued)

Dominance of Cluster by a Few Researchers
in the Four Cluster Divisions

Cluster (Number) Author	Cited Documents in Cluster	Citing Documents for Cluster	Summed Citations to Author's Work	Number of Cited Books or Chapters by Author	Number of Other Documents by Author
INVESTMENT (109)	19	134			
D. Jorgeson			79	1	2
R. Eisner			61	1	2
PSYCHOPHYSICAL SCIENCE (128)	10	108			
S. Stevens			93	-	3
D. Curtis			48	-	3
HYPNOTIC SUSCEPTIBILITY (178)	16	157			
T. Barber			88	1	3
R. Shor			77	-	4
A. Weitzenhoffer			87	2	-
CONSUMER DEMAND (226)	2	111			
G. Becker			72	-	-
K. Lancaster			66	-	-

TABLE 4 (Continued)

Dominance of Cluster by a Few Researchers
in the Four Cluster Divisions

Cluster (Number) Author	Cited Documents in Cluster	Citing Documents for Cluster	Summed Citations to Author's Work	Number of Cited Books or Chapters by Author	Number of Other Documents by Author
		Isolates			
ANALYSIS OF CATEGORICAL DATA (302)	12	113			
L. Goodman			137	-	6
EDUCATION (329)	2	133			
B. Bloom			119	1	-
D. Krathwohl			37	1	-
TEACHER EXPECTATION OF PUPIL PERFORMANCE (397)	9	180			
R. Rosenthal			165	1	-
RESOURCE ALLOCATION AND LIABILITY (445)	5	124			
K. Coase			109	-	-

TABLE 4 (Continued)

Dominance of Cluster by a Few Researchers
in the Four Cluster Divisions

Cluster (Number) Author	Cited Documents in Cluster	Citing Documents for Cluster	Summed Citations to Author's Work	Number of Cited Books or Chapters by Author	Number of Other Documents by Author
		Isolates			
CROSS-CULTURAL ANALYSIS (485)	13	101			
G. Murdock			43	-	2
R. Nuroll			22	1	-
PSYCHIATRIC SOCIOLOGY (563)	14	123			
B. Dohrenwerd			81	1	3
NARCOTIC ADDICTION (604)	12	111			
V. Dole			66	-	3
POLITICS (641)	3	169			
D. Easton			210	4	-
PSYCHOANALYTIC THEORY (739)	13	208			
S. Freud			459	1	-

TABLE 4 (Continued)

Dominance of Cluster by a Few Researchers
in the Four Cluster Divisions

Cluster (Number) Author	Cited Documents in Cluster	Citing Documents for Cluster	Summed Citations to Author's Work	Number of Cited Books or Chapters by Author	Number of Other Documents by Author
		Isolates			
HABITUATION (829)	3	101			
R. Thompson			80	-	2
P. Groves			60	-	1
HOLLAND'S VOCATIONAL PREFERENCE INVENTORY (901)	5	102			
S. Holland			136	2	2
LIFE EVENTS AND MENTAL STATUS (903)	16	120			
R. Rahe			172	1	8
COGNITIVE STYLE AND PERSONALITY (1205)	2	257			
H. Witikon			304	2	-

a) The named authors' summed citations exceed roughly two-thirds the number of citing documents for the entire cluster.

b) These were nearly all journal articles, but include a few technical reports, manuals, etc.

1102 M. Tell: *A Note about China's Scientific and Technological Information System* (July 1980) 50 p.
1104 S. Schwarz: *A National Documentation and Information Centre of the Kenya National Council for Science and Technology* (Publ. as Unesco Report PGI/80/176 [Paris 1980]) 50 p.
1105 S. Schwarz: *Pest Management Documentation Service at the International Centre of Insect Physiology and Ecology (ICIPE)* (Publ. as Unesco Report PGI/80/161 [Paris 1980]) 31 p.
1107 M. Brawne and S. Schwarz: *Development of the Institute of Scientific and Technical Information of China (ISTIC)* (Publ. as Unesco Report PGI/81/104 [Paris 1981]) 83 p.
1113 S. Schwarz: *Slutrapport till DFI för projektet "Användning av minidator i forskningsbibliotek"* (jan. 1983) 18 p.
Analysis (Dec. 1980) 163 p.
1117 G. Hessler: *Synpunkter på numeriska databaser* (juni 1983) 49 p.
2018 *LIST TECH 80/83. List of foreign periodicals and serials in Swedish libraries within the fields of mathematics, physics, chemistry, technology, architecture, photography, geodesy and industrial economics* (1983) 214 p.
2019 R. Hjerppe: *Supplement to a "Bibliography of Bibliometrics and Citation Analysis"* (TRITA-LIB-2013) [Publ in *Scientometrics 4* (1982) 241–281]
4066 R. Gaillardin, F. Gourd and D. Sanz: *Pascal Data Base. File Description and Indexing Rules in Chemistry, Biology and Medicine* (Jan. 1980) 22 p.
4068 Paralog AB: *An Introduction to 3RIP – An Interactive Text Base System* (March 1981) 33 p.
4069 M. Löfström, J. Hultgren and M. G. Lindquist: *Framework for a Future Swedish Policy for Research and Development in Information Science and Technology* (March 1981) 60 p.
4071 R. Larsson and J. Sunnebäck: *3RIP version 4.0 (including the Euronet Common Command Language)* (Oct 1981) 48 p.
4075 S. Abrahamsson, R.E. Carter och B. Sundman: *Utveckling och användning av icke-bibliografiska databaser* (Mars 1982) 34 p.
4076 Lian Ya-chun: *RAMAS: The RITL Automated Management System* (Nov. 1982) 90 p.
4077 M. Löfström: *A Description of the Text Data Base System TDBS* (Nov. 1982) 28 p.
4078 G. Werme: *RAMAS – KTHBs integrerade bibliotekssystem för minidator. Önskat innehåll och slutprodukter i ett planerat förvärvssystem* (dec. 1982) 70 p.
4086 B. Barnholdt and N Højer-Pedersen: *The ALIS Online Circulation Control System of Danmarks Tekniske Bibliotek* (May 1983) 23 p.
5008 L. Klasén och P. Sabsay: *Informationssökning för tekniker och naturvetare* (aug. 1978, 7.e uppl. aug. 1983) 71 p.
5009 L. Höglund et al.: *En studie av informationssökning och biblioteksanvändning i högre utbildning* (april 1979) 64 p.
6013 S. Schwarz and U. Willers (eds): *Knowledge and Development–Reshaping Library and Information Services for the World of Tomorrow (A Festschrift for Björn Tell)* (Sept. 1978) 307 p.
6014 R. Hjerppe: *An Outline of Bibliometrics and Citation Analysis* (Oct. 1978) 82 p.
6017 O. Persson: *Critical Comments on the Gatekeeper Concept in Science and Technology* (Jan. 1980) 14 p.
6018 S. Schwarz: *Problems of I&D Services in LDCs – The Small Systems Syndrome* (March 1982) [Publ. in *Tidskrift för Dokumentation 37* (1981) 5/6]
6019 A. Bookstein: *Recent Development in the Theory of Information Retrieval* (Dec. 1982) 28 p.
6020 S. Schwarz: *Scientific and Technical Information in Development – the Small Systems Syndrome and the Inverted Binocular Strategy* (Jan. 1983) [Publ. in *Journal of Documentation 39* (1983) 38–47].

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